Communications and Telemetry Transport

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Semi-Annual Review of the FY97 SOMO/MO&DSD Technology Development Program

April 15, 1997

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FY97 Accomplishments and Work Plans

GSFC

- Small Satellite Access - Accomplishments
  - Completed analysis of May 1996 EUVE experiment, issued analysis report, and submitted paper to IEEE Transactions
  - Completed analysis of additional antenna pointing cases and access times with a constellation of 3 TDRS spacecraft, submitted report, and revised paper for IEEE Transactions
  - Presented papers on DAMA concepts at the 1996 International Telemetering Conference
  - Began development of real-time Digital Signal Processing implementation of Doppler Tracking Algorithm
- Small Satellite Access - Work Plan
  - Continue with development and testing of real-time Doppler tracking algorithm
  - Test antenna pointing concepts with an additional satellite
  - Design RF signal generation/reception capability to simulate satellite access from campus
  - Begin design of a hitchhiker payload to act as a testbed for concept testing
  - Submit paper “Results for Non-gimballed Antenna Pointing” to the International Telemetering Conference

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FY97 Accomplishments and Work Plans (Cont'd)

GSFC

- Coding and Performance Bounds - Accomplishments
  - Completed analysis of the design of transparent Turbo Codes and the performance degradation suffered when using transparent codes
  - Determined the performance of Turbo Codes in pulsed CW RFI environment
  - Designed a rate 3/4 Turbo Code that is within 0.75 dB of capacity
  - Presented results of Turbo Codes in RFI environment at the November 1996 CCSDS meeting
  - Designed an initial test of Turbo Codes through a TDRS link
- Coding an Performance Bounds - Work Plan
  - Plan presentation of results at the April 1997 CCSDS meetings
  - Continue work on the design of bandwidth-efficient Turbo Codes
  - Perform Turbo Code testing at the White Sands Complex using the TDRS channel

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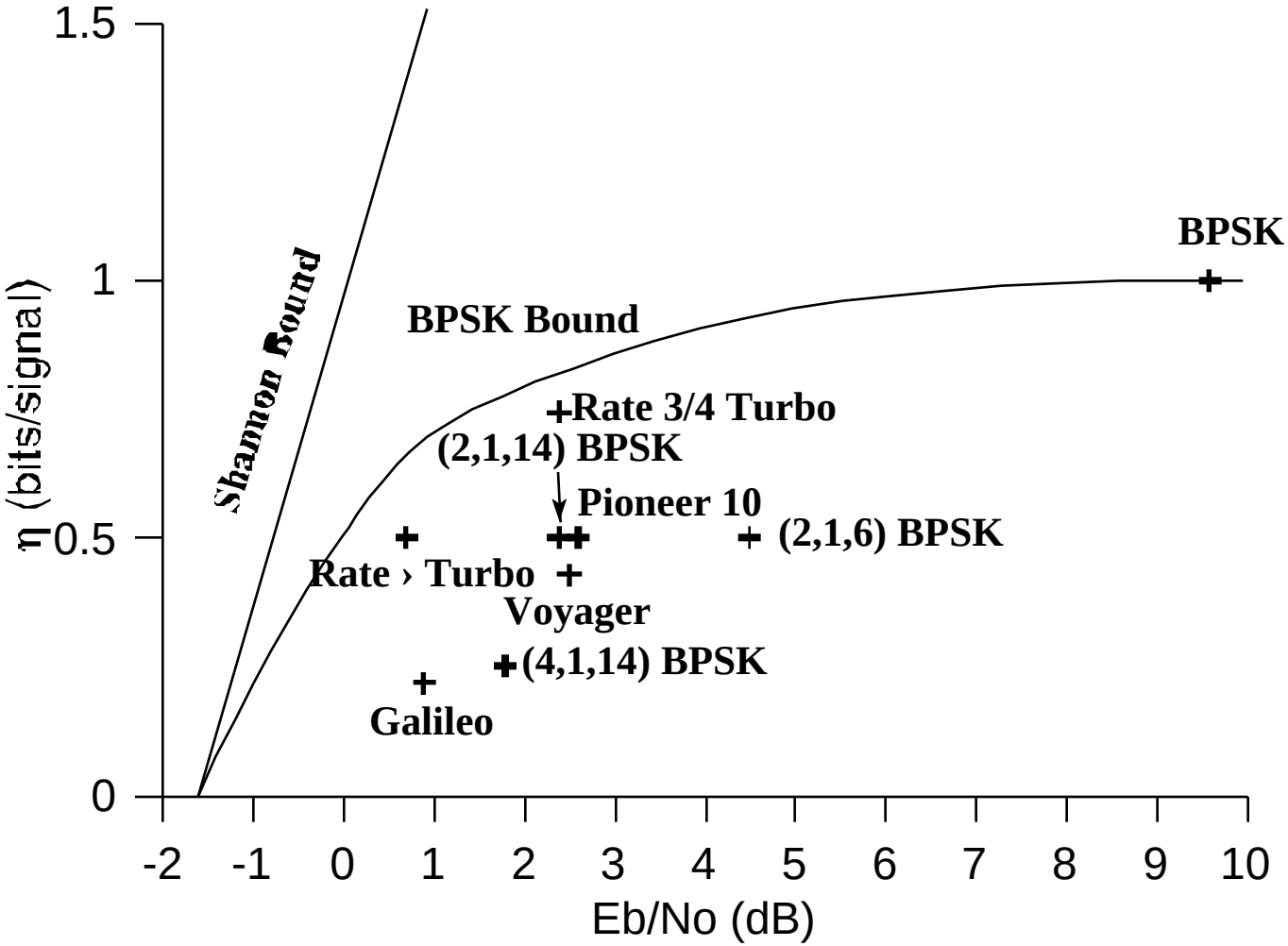
FY97 Accomplishments and Work Plans (Cont'd)



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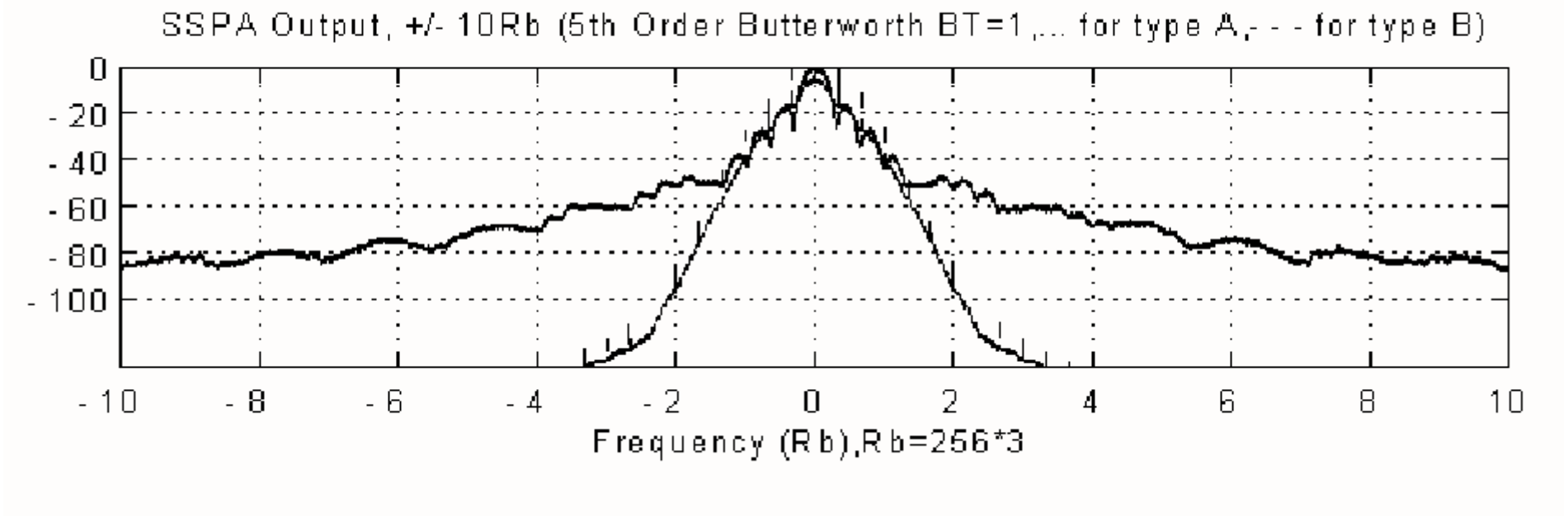
FY97 Accomplishments and Work Plans (Cont'd)

GSFC

- Bandwidth-Efficient Modulation Techniques - Accomplishments
  - Produced a suite of simulations to model constant-envelope and non-constant-envelope 8-PSK links with various filters and data asymmetries
  - Generated reports to CCSDS RF panel
  - 66% completion of verifying simulation work via hardware verification
  - Detected problem with simulated power amplifier model
- Bandwidth-Efficient Modulation Techniques - Work Plan
  - Complete hardware implementation
  - Resolve the power amplifier problem
  - Submit paper "Pulse shaped Constant Envelope 8 PSK Modulation Study" to the International Telemetering Conference
  - Begin digital, non-linear equalization simulations

Bandwidth-Efficient Modulation Techniques - Accomplishments



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FY97 Accomplishments and Work Plans (Cont'd)

- Space Protocol Test and Evaluation - Accomplishments
  - Developed Internet socket interface and transmission methodology to allow external users to send data to NMSU for processing through the NASA satellite channel simulator error-generation hardware
  - Developed Internet interface to allow users to register as valid users of the error generation hardware, specify user satellite transmission and orbital characteristics, and specify TDRS characteristics desired
  - Integrated NMSU front end to the NASA system and verifying correct system hardware and software operation
  - Developing hardware add-in VME board to generate satellite-hop delay characteristics
- Space Protocol Test and Evaluation - Work Plan
  - Complete verification of integrated system hardware and software and complete fixes of hardware disk problems detected during verification process
  - Complete development and test of link delay VME module
  - Integrate Satellite Tool Kit path predictions into error-generation path prediction software (original methodology was fixed to a single orbit path and a single epoch)
  - Begin testing with packet communication protocols
  - Submit paper "User Interface for Space Protocol Testing and Evaluation" to the International Telemetering Conference

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FY97 Accomplishments and Work Plans (Cont'd)

GSFC

- Milestone Status - Small Satellite Access of the Space Network
  - Perform analysis of additional antenna pointing cases: status = completed; NMSU Technical Report "Further Results for Non-gimballed Antenna Pointing", NMSU-ECE-96-018, December 1996 delivered to NASA
  - Report on baseline EUVE tests performed and analysis of results: status = completed; NMSU Technical Report "Analysis of EUVE Experiment Results," NMSU-ECE-96-016, December 17, 1996 delivered to NASA and submitted to IEEE for publication consideration
  - Analysis of Doppler Extraction algorithm - the basic algorithm has been initially tested, discussion is proceeding with Motorola on implementation requirements in hardware, basic concept paper is under development for submission to one of the digital signal processing professional conferences
- Milestone Status - Coding and Performance Bounds
  - Complete encode/decoder design: with the advent of Turbo Codes, we has changed our scope from codes based on the concatenated code standard to these more powerful codes
  - Analysis of alternative code options - we have created turbo code simulations to examine their performance in a variety of situations including RFI, and AWGN. A tutorial paper on turbo codes was written and sent to NASA; the paper was also submitted to the IEEE Transactions on Communications and the 1997 Global Communications Conference.